Technical News Briefs

New Technical Developments

SENSOR SYSTEM MONITORS SURFACE ROUGHNESS/TOOL CONDITION FOR AUTOMATED MANUFACTURING

An ultrasonic system has been developed to monitor the surface finish of stationary or moving surfaces. Pulsed ultrasound is guided from a source transducer to the monitored surface by a flowing stream of liquid. Part of the ultrasound interacts with the monitored surface and is back-scattered up the liquid stream to the same transducer. The amplitude of the returned ultrasound is related to the roughness of the surface.

The system was motivated by the need for in-process part monitoring during automated manufacturing. It was designed to take advantage of the cooling systems that are used commonly on high-speed metal-cutting machinery to flood the work piece with a cooling and lubricating fluid. The steady stream of coolant acts as a guide to "couple" the ultrasound to the surface of the part.

Surfaces with average roughness values from 25 to 1000 microinches have been studied. A resolution of about 25 microinches appears to be possible. Cylindrical surfaces rotating with surface speeds in excess of 1000 feet/min have also been successfully monitored.

In addition to monitoring part finish in real time and in situ the system provides the basis for a much improved tool-control strategy. Using sensory feedback, when the system detects an unacceptable surface finish due to worn or chipped tooling, a "change tool" order can be given to a machining or turning center.

Additional work is being performed at higher frequencies necessary for smoother surfaces and a prototype is being developed for testing on a machining center in the NBS Automated Manufacturing Research Facility. A patent on the system is being applied for.

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ULTRASONIC SENSOR DEVELOPED TO CHARACTERIZE SURFACE MODIFIED METALS

A new ultrasonic sensor system for measuring the depth and elastic properties of treated surfaces of steels and other metal alloys has been developed by an NBS scientist and two guest workers from Johns Hopkins University.

The sensor system is made up to two transducers, one to launch ultrasonic waves and another to receive them as they move across the surface of the materials [1]. By precise measurements of the velocity of the ultrasonic waves, the thickness and elastic properties of the modified surface are determined. The homogeneity of the surface layer can be examined, and flaws or any delaminations that may exist between the modified surface layer and the substrate can be detected.

One of the important advantages offered by the new ultrasonic sensor is that the waves can be sent over irregular or curved surfaces of metal components to accurately estimate the depths and properties of modified surface areas. It is the only known method for making the measurements without destroying the finished material.

Research on the ultrasonic sensor was performed as part of a program to develop nondestructive evaluation techniques for new rapid solidification technologies.

Additional developments using noncontact ultrasonic transduction techniques such as those based on lasers or electromagnetic acoustic transducers may lead to in-process sensor systems to measure metal product characteristics at various points in the manufacturing process.

References

[1] Elkind, B. J.; M. Rosen and H. N. G. Wadley, Ultrasonic characterization of surface modified layers, to appear in METRONS, Series A.

IMPROVED FLEXURE–HINGE INSTRUMENT STAGE PATENTED

A patent has been granted for an improved positioning stage for precision measurement instruments. The development is based on a new design for the so-called "flexure" hinge [1]. Flexure hinges are made by cutting out material from opposite sides of a normally rigid member, such as a steel bar, leaving only a thin web-like section at that point. Such hinges are sometimes used in precision machinery—in this case a positionable specimen stage for microtopographic mapping.

The NBS patent [2] covers a new design for the flexure hinge that allows the flexing member to elongate slightly while bending. The new hinge is incorporated in a stage that is capable of smooth motion in an almost perfect plane along either the x- or y-axis without sideways displacement. In the prototype version of the stage, pitch, roll, and yaw were no greater than 3 arc-seconds for both x and y motion, corresponding to deviations on the order of 10 nanometers. Within its limits of motion (a 5-mm square), it improves on stages with conventional flexure hinges, which cannot move along one axis without some movement along the other; and on stages that achieve straight-line movement using mechanical sliding joints or roller-element bearings, which cannot move as smoothly as a flexure stage.

References

[1] Teague, E. C.; R. D. Young, F. E. Scire, and D. Gilsinn, Para-flex stage for microtopographic mapping, to appear in Rev. Sci. Inst.

[2] Scire, F. E. and E. C. Teague, Flexure hinge, U.S. Patent No. 4,559,717; December 24, 1985.

HEAT PIPE OVEN AS A SOURCE FOR MOLECULAR BEAMS

A heat pipe oven source for a molecular beam has been developed [1] as a superior source for atoms or molecules to be used in atomic frequency standards. The oven can also be used in studies of atomic and molecular properties. The new oven is an improvement over earlier ovens in that it limits the amount of non-useful materials ejected from the oven, by being insensitive to orientation or acceleration and by eliminating the normally used small collimation channels that are easily plugged.

The oven consists of a hollow cylinder made of porous material, such as tungsten, molybdenum, stainless steel, or alumina silicates that can be wetted by the material used in the beam. One end of the cylinder is closed and the working material there is heated to evaporation forming a beam that is partially collimated, as determined by the diameter to length of the oven. Material that is not ejected in the beam strikes the wetted porous sides of the oven and is carried back to the hot end by wick action for re-use. This gives the device a longer operating life than conventional for a given amount of material.

For further information contact R. Drullinger, National Bureau of Standards, Boulder, CO 80303.

References

[1] Drullinger, R., Heat pipe oven, U.S. Patent No. 4, 558, 218.

NBS ESTABLISHES STANDARD FOR COMPUTER PASSWORD USAGE

Passwords have been used for centuries to prove authorization to access valuable items. Today, they commonly are used to help control access to computer systems, data files, and networks. It is recognized that passwords are neither the only nor necessarily the best method of controlling access. However, if properly used, they can provide a reasonable level of protection.

A difficulty for computer system managers and users was the lack of standard usage requirements. As a result, password-based access control mechanisms were often inconsistent and ineffective. There was no agreement on such issues as minimum password length, lifetime (time between changes), or composition. To address this need, NBS recently published Federal Information Processing Standard 112, *Password Usage* [1], which establishes minimum password usage requirements for those computer systems using passwords although it does not require that passwords be used in all systems).

Federal Information Standards Publications (FIPS PUBS) are the vehicles by which a wide range of information processing standards and publications are issued to Federal Government computer users. These standards are mandatory for Federal agencies, and they are often adopted by private sector organizations. Of the more than 100 FIPS pubs issued over the years, several have addressed the issues of computer security.

Two types of password are defined: *personal passwords* which are used to authenticate a claimed identity (Example: "I am Joe Smith. I prove this by giving you my password. 'CLAPFOBS'."), and *access passwords* which are used to validate claims of access for systems resources such as data files (Example: The password for file PAYROLL is 'HOKFUST'.)

The Password Usage Standard lists 10 factors affecting password usage and minimum criteria for each area. The factors are:

Composition	–Types of characters that can be used in a password.
Length	–Minimum and maximum number of characters in a password.
Lifetime	–Maximum time a password is valid.
Source	–Who generates the passwords?
Ownership	–Who controls the passwords?
Distribution	–How are new passwords communicated to the user?
Storage	–How are passwords stored and protected?
Entry	–How are passwords entered into the system by a user?
Transmission	–How are passwords protected between entry by the user and receipt by the system?
Authentication Period	–For how long is the authentication established by a password valid?

Criteria are established both for manually administrated password systems and for automated password administration mechanisms.

It is important to note that this standard is applicable for a broad range of uses, from large-scale, multi-user computer systems to personal computer systems, wherever passwords are used.

This new standard will help computer system managers and security officers measure their level of compliance with minimum password management requirements—something they were unable to do before. Since password-based access controls are used as the primary access control mechanism in almost all computer systems, this standard will provide significant improvement in the overall security and protection afforded valuable data and information resources throughout the Federal Government.

References

[1] FIPS PUB 112, *Password Usage*, National Technical Information Service (NTIS), Springfield, VA 22161; $9.95.

INTER-ELEMENT INTERACTIONS IN LARGE PHASED ARRAY ANTENNAS

It is difficult to obtain information on the electromagnetic fields produced by large phased array antennas at large distances (far filed patterns). However, the field patterns of the sub-arrays which form the building blocks of such arrays are well known and can be accurately measured. A procedure is being developed [1] to predict the far field patterns of phased array systems from the elementary patterns formed by the sub-arrays. The analysis to date has been limited to one-dimensional arrays and does not include the effects of multiple reflections on the sub-array field patterns, but future work is planned to extend the formalism already developed. A major goal of this work is to be able to predict the far field patterns of a large phased array using input data obtained from measurements in the near field from the sub-arrays.

References

[1] Muth, L. A., Interelement interactions in phased arrays: Theory, methods of data analysis, and theoretical simulations, NBS Technical Note 1091 (1985).

A MEASUREMENT SYSTEM FOR DETERMINING THE POWER DELIVERED TO AN ANTENNA

Standard gain horn antennas are used in the National Bureau of Standards anechoic chamber to produce well-characterized electromagnetic fields. A major uncertainty in the calibration procedure arises from the uncertainty in the net power delivered to the antenna. A procedure has been developed for measuring the net power delivered and evaluating its uncertainty [1]. This procedure permits the automated system used to establish known electromagnetic fields to be largely self-calibrating; this is possible since the key parameters upon which the net power delivered to the antenna depend can be obtained directly by replacing either the antenna or one of the power meters in the system by loads with known characteristics.

References

[1] Kanda, M. and R. D. Orr, A radio-frequency power delivery system: Procedures for error analysis and self-calibration. NBS Technical Note 1083 (1985).

New Standard Reference Materials*

STANDARD ACID SOLUTIONS FOR DETERMINATION OF pH IN RAINWATER

In November, 1983, 12 laboratories agreed to participate in an interlaboratory test of pH measurements in rainwater [1]. The tests were conducted to determine the feasibility of using dilute solutions of

*SRMs can be ordered from the Office of Standard Reference Material, NBS, Gaithersburg, MD 20899, Telephone 301-921-2045.

a strong acid as working standrds for pH measurements in acid deposition studies. Scientists at the National Bureau of Standards independently tested sets of the acid samples.

Results of ruggedness test experiments, which were also conducted, showed that stirring has an adverse effect on the measurement of pH of dilute acid solutions by amplifyng the random noise and biasing the measured values. Moderate temperature control (±0.5 degree C) was found to be sufficient for maintaining measurements accurate to 0.01 pH unit. The results also demonstrated that the addition of neutral salts cannot be tolerated in accurate pH measurements because these salts change the mean activity coefficients of solutions, and also unpredictably change the electrode behavior and hence, the measured pH.

The use of standard acid solutions is recommended for all those involved in network monitoring of wet deposition to improve the intercomparability of the measurements as a function of time and location. To aid in this endeavor, Standard Reference Material, SRM 2694, Simulated Rainwater, has been prepared and analyzed and is available through the Office of Standard Reference Materials. The SRM consists of a set of two 50 mL solutions in polyethylene bottles. The nominal pH of Level I is 4.3 and that of Level II is 3.6. The acidity and the specific conductance have also been determined, as well as several of the major cations and anions commonly found in rainwater.

References

[1] J. Res. Natl. Bur. Stand. 91-1 (1986).

NEW MATERIAL TO IMPROVE MEASUREMENTS OF PCB LEVELS IN BLOOD

Tests for amounts of polychlorinated biphenyls (PCBs) in blood samples can be checked for accuracy with a standard reference material (SRM) now available from the National Bureau of Standards. Such tests are important for determining the exposure to the toxic compounds of chemical industry employees or others who must work with PCBs.

SRM 1589 consists of freeze-dried human blood serum which is "spiked" with 106 nanograms of Aroclor 1260 per gram of serum. Aroclor 1260 is a mixture of PCBs found in some transformer oils. The SRM, which must be reconstituted with 10 milliliters of distilled water, is intended for use in the calibration of analytical instruments used for measuring the concentration of PCBs in blood. It also may be used as a primary standard against which secondary reference materials may be compared. Certified to be accurate within 1 percent range, the SRM costs $163 for a three-vial set.

ENVIRONMENTAL STANDARD DEVELOPED FOR USED LUBRICATING OIL

Regulations of the Environmental Protection Agency require that used oils which contain more than 50 parts per million of chlorine must be analyzed for the presence of polychlorinated biphenyls (PCBs), which are toxic compounds. Samples which do, or do not, have to undergo analysis for PCB content can be identified by tests which show the total concentration of chlorine in a used lubricating base oil. A new standard reference material, SRM 1818 (Total Chlorine in Lubricating Base Oil), consists of a series of five 20-gram ampules of re-refined lubricating base oils having total chlorine concentrations ranging from 30 to 600 parts per million. The cost is $200.

NEW GLASS STANDARDS CERTIFIED FOR CHEMICAL CONTENT

The chemical composition of glass is important in determining its properties, such as thermal performance, resistance to radiation, electrical conductivity and durability. In order to aid glass manufacturers and the designers of glass products who require specific material performance, the ASTM Committee C14 Committee on glass and glass products has recently revised recommended procedures for the determination of the chemical composition of glass. The improved procedures include conventional techniques such as wet chemical analysis, as well as x-ray fluorescence and neutron activation analysis.

Use of the new procedures for the chemical analysis of glass will be facilitated by three new standard reference materials. SRM 1411 (Soft Borosilicate Glass), SRM 1412 (Multicomponent Glass), and SRM 1413 (High Alumina Sand). These SRMs are expected to play a key role in quality control and product performance, the research and development of new glasses, and in the manufacture of better quality glasses. The cost of the new SRMs is $172 per unit.